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(54) Clinch nuts and assembly machines

(57) A U-shaped sheet metal clinch nut 10 receives an extruded portion 32 of a workpiece 30 in an aperture 16 in a first arm 12, and rotation preventing teeth or serrations 24 lock the nut against rotational movement. A self-tapping fastener 34 is inserted, creating threads in the workpiece extrusion 32 and then in a second arm 14 of the clinch nut. Tightening of the fastener causes the second arm to deflect towards the first arm 12, thus locking the fastener 34 against retrograde movement. Also disclosed is a simple tool for advancing an interconnected strip of clinch nuts, severing the leading nut, and staking the workpiece to it.

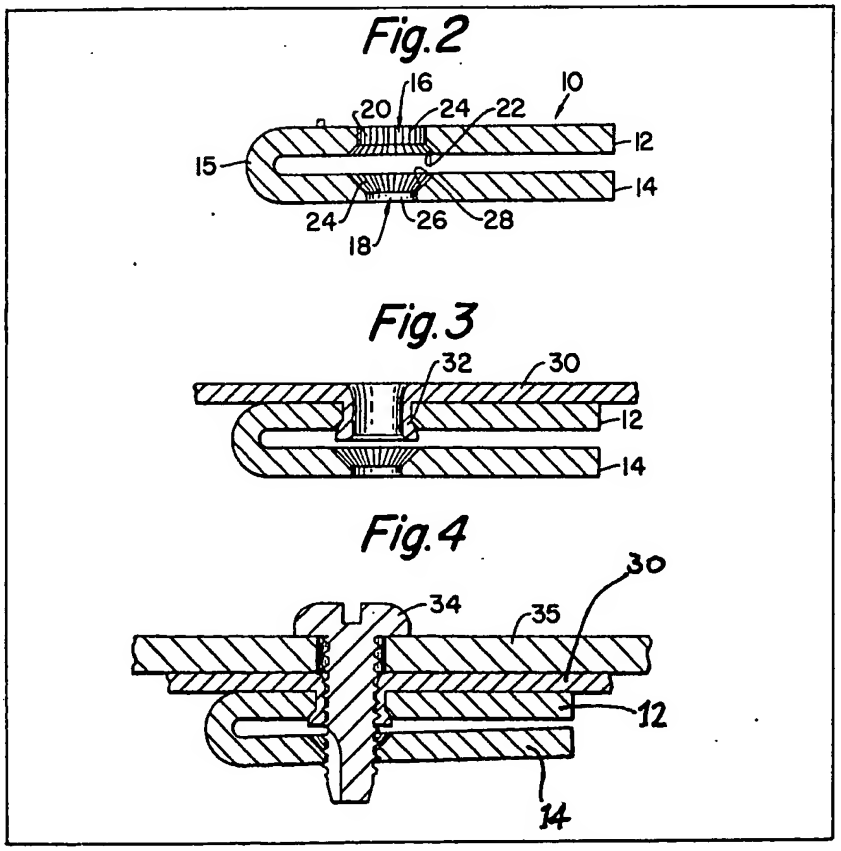

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Fig.1

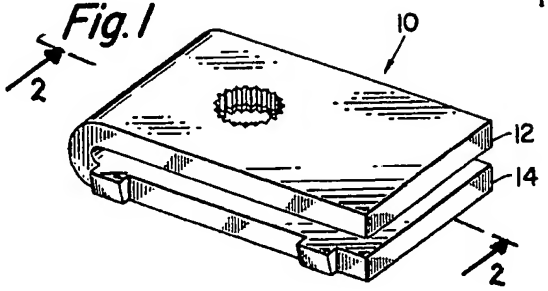


Fig.2

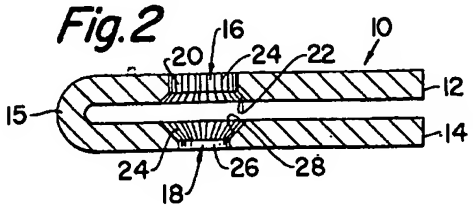


Fig.3

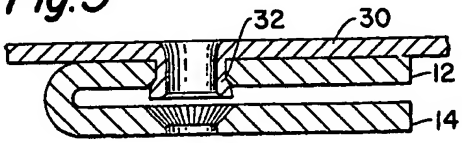


Fig.5

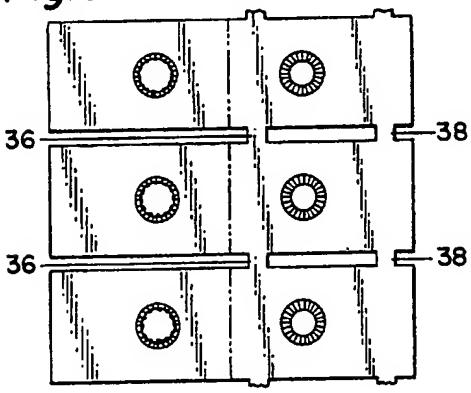


Fig.4

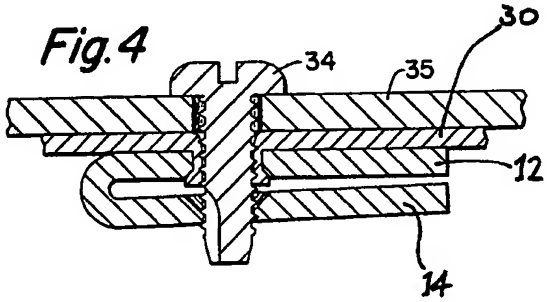


Fig.6

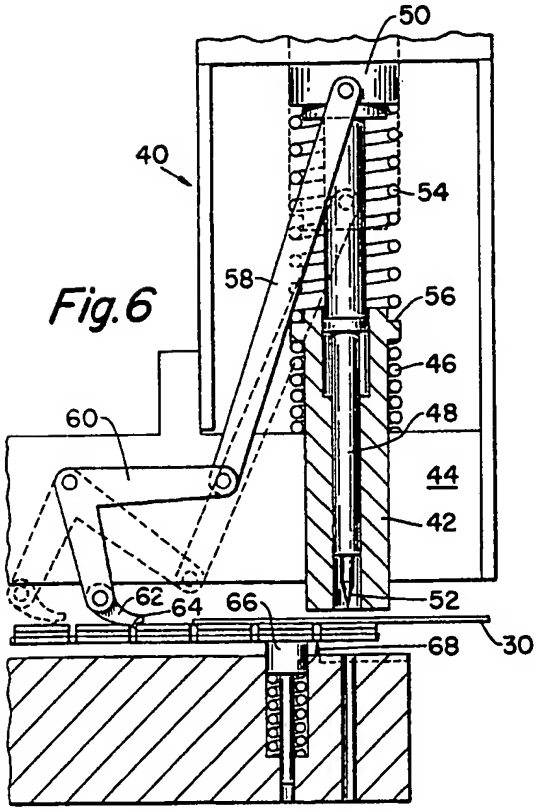


Fig.7

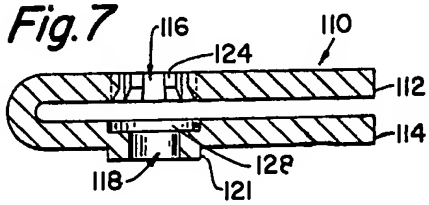


Fig.8

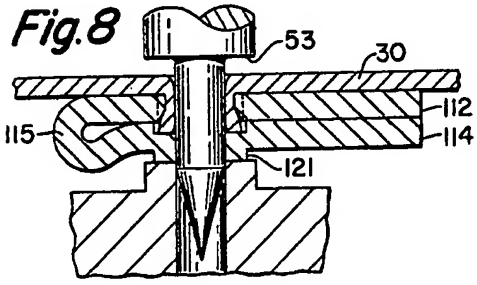
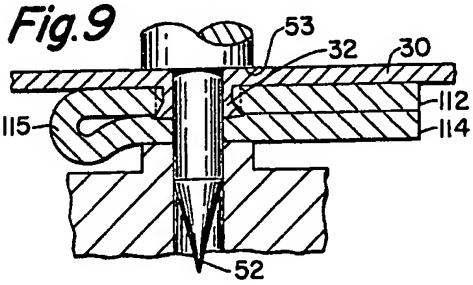


Fig.9



SPECIFICATION
Clinch nuts and assembly machines

The present invention is directed to clinch nuts and apparatus for installing these clinch nuts to workpieces. More particularly, the present invention is directed to sheet metal clinch nuts which can be easily and economically manufactured and installed.

Several attempts have been made to devise a clinch nut with a space to receive a workpiece extrusion so that the nut may be staked into position on a workpiece. These prior art clinch nuts are made from rod stock and necessarily involve expensive manufacturing steps of boring, counterboring and thread tapping, in addition to the difficulties in handling and machining such parts. Further, each of these clinch nuts relies on an undercut to receive extruded material to retain the nut to the workpiece. Such undercuts are difficult to machine and unreliable in their retention characteristics due to the reluctance of the extruded metal to fill the undercut.

A clinch nut according to the present invention is of sheet material, and comprises a first arm member which can engage a workpiece surface with one side thereof; a second arm member interconnected to the first arm member on the side opposite from the workpiece engagement and extending generally parallel to said first arm member; a first aperture in said first arm member adapted to receive an extruded portion of said workpiece; a second aperture in said second arm member which is generally coaxial with said first aperture, at least a portion of said second aperture having a diameter which is less than the diameter of all portions of the first aperture; said first aperture including a first portion with one diameter and a second portion with a larger diameter, said second portion being on the side away from workpiece engagement, and said first aperture also including rotation preventive means, whereby the clinch nut may be axially and rotationally fixed by extruding a portion of said workpiece into said first aperture as by staking, said extrusion extending at least into the second portion of said first aperture.

The present invention overcomes the difficulties and deficiencies of the prior art clinch nuts. A clinch nut embodying the present invention comprises first and second arms which are interconnected. The first and second arms can be stamped from sheet material and each arm includes an aperture which can be formed during the stamping step or easily added or modified during a secondary machining step. The clinch nut is bent into a U-shaped configuration to bring the two apertures into axial alignment with the interconnecting portion forming the base of the U. One aperture is larger than the other so as to accommodate an extruded portion of the workpiece. The other aperture is sized to accommodate a self-tapping screw shank which initially taps into the extruded metal and then into the aperture in the second arm. As the screw is tightened into the clinch nut, it will draw the second arm angularly towards the first as a result of the resilience of the spring arm formed by the interconnecting portion at the base of the U. This will effectively cause a locking of the threads and prevent backing out of the fastener. In addition, whereas most clinch nuts must be made for a particular workpiece thickness, the clinch nut embodying the present invention can accommodate a range of material thicknesses, since the area between the two arms can accommodate the additional extruded material.

The clinch nut embodying the present invention is capable of improved retention by the workpiece, can be more easily and cheaply made, and can provide a locking feature not available with prior art clinch nuts. These and other features, advantages and objects of the present invention will be more fully appreciated following a reading of the following description, when taken in conjunction with the accompanying drawings. In these drawings:—

Figure 1 is a perspective view of one clinch nut embodying the present invention;

Figure 2 is a cross section taken along line 2—2 in Figure 1;

Figure 3 is a cross section similar to Figure 2 showing the workpiece material extruded into the nut;

Figure 4 is a cross section depicting a fastener retaining a panel to the base workpiece;

Figure 5 is a top elevational view of a strip of clinch nuts as they exit from a punch before the arms are bent parallel;

Figure 6 is a schematic view in vertical section of an installation tool useful in staking the workpiece into the nut;

Figure 7 is a cross section of a second embodiment of the present invention;

Figure 8 is a cross section of an initial step in the staking of the Figure 7 embodiment; and

Figure 9 is a cross section of the Figure 7 clinch nut as the staking is completed just prior to retraction of the punch.

The first clinch nut embodying the present invention is shown generally at 10 in Figures 1 and 2. A first arm 12 extends generally parallel to a second arm 14 interconnected by region 15, with each arm containing its respective aperture 16, 18. These first (16) and second (18) apertures are generally coaxial, with each aperture having two portions or sections. The first portion 20 of aperture 16 is generally cylindrical while the second portion 22 has a larger diameter and may be frustoconical in shape. Both portions may have serrations 24 for a purpose described in more detail hereafter.

Second aperture 18 also has a cylindrical section 26 and a frustoconical section 28. Cylindrical section 26 has a smaller diameter than cylindrical portion 20. Cylindrical portion 20 must be larger in order to accommodate the extruded material 32 from workpiece 30. Cylindrical section 26 has a diameter which is less than the thread crest diameter of a self-tapping fastener 34

(Figure 4). This fastener may be of either the thread-forming or thread-cutting varieties.

In use, the nut 10 is positioned beneath the workpiece 30 in the region of attachment. Some form of piercing means having a diameter generally equal to the root diameter of screw 34 is plunged through the workpiece 30 into the aperture 16, forcing the material of the workpiece hole to be extruded into aperture 16, thereby staking nut 10 in place (Figure3). The extrusion 32 extends at least into the second portion 22 of the aperture 16 which has a greater diameter than the first portion 20, so that the nut is secured against lateral and axial movement. The serrations 24 engage the exterior of the extrusion 32 and in fact are filled by the extrusion material, inhibiting rotation of the nut.

Depending on the thickness of the workpiece 30 and the amount of closing between arms 12 and 14 that may be caused by staking, extrusion 32 can extend into section 28 of aperture 18, and hence the need for serrations in it as well. Self-tapping fastener 34 (Figure 4) is then threaded into extrusion 32 and on into section 26 whose inner diameter is specifically adapted to receive this particular size fastener. Fastener 34 clamps panel member 35 to the workpiece 30. As the fastener is tightened into section 26, arm 14 is resiliently deflected towards arm 12 in an angular fashion, thereby locking the threads of the fastener with the newly formed threads in the clinch nut and preventing loosening of the fastener.

Figure 5 depicts a strip of such clinch nuts 10 which have been stamped from sheet stock and remain interconnected by small material widths 36 and 38. Apertures 16 and 18 can also be easily stamped, drilled, shaped and serrated due to this configuration. Folding over of arm 12 completes the formation of the strip of clinch nuts.

A further feature of the present invention is a tool for installing a clinch nut onto a workpiece from an interconnected strip of such nuts, comprising a first outer piston mounted for longitudinal movement; a second inner piston mounted for longitudinal movement within a cavity in said first piston; said second piston including piercing means on the leading end thereof, cylinder means connected to said second piston and adapted to move said second piston through a distance exceeding the length of the cavity in said first piston; linkage means pivotally connected to said cylinder means and to a finger; spring biased plunger means positioned generally opposite said first piston; and severing means positioned adjacent said plunger means.

Figure 6 depicts a device 40 for automatically feeding and staking the clinch nuts. A first piston 42 is slidably mounted in frame 44 and biased upwardly by spring 46. A second piston 48 is slidably mounted within the first piston. Second piston 48 is connected to a power cylinder 50 which may be pneumatic, hydraulic or electric (i.e. a solenoid). The opposite end of the second piston has a piercing means 52 affixed thereto. A spring 54 is mounted between the moving portion of power cylinder 50 and a reaction surface 56 of cylinder 42.

Linkage member 58 is connected to power cylinder 50 at one end and to rocker arm 60 at the other. Pivotally connected to the rocker arm is a pusher finger 62. The finger 62 preferably has a plurality of tangs 64 (one of which is shown) to engage between adjacent clinch nuts 10 and advance the strip to the punch. The tangs 64 have a tapered rear edge so that they may readily cam out of the slot between clinch nuts on the retraction stroke. Spring biased plunger 66 supports the strip adjacent severing edge 68.

The operation of the staking device will be more fully described in conjunction with a second clinch nut embodiment which is depicted in Figures 7 to 9. This alternate embodiment 110 has anti-rotation means in the form of teeth-like projections 124 located in aperture 116. Also, the second section 128 of aperture 118 is punched into the upper face of arm 114 and the displaced material forms an embossment or ring 121.

In operation, as power cylinder 50 moves downwardly, pistons 42 and 48 move downwardly together due to the fact that spring 54 is stiffer than spring 46. Piston 42 engages the upper face of workpiece 30 pushing it and the nut strip downwardly against the upward pressure of plunger 66. Material widths 36 and 38 are driven into and cut by severing edge 68. Piercing means 52 now moves downwardly into the workpiece 30 as spring 46 becomes fully compressed and spring 54 begins to collapse.

The two arms 112 and 114 may come into contact as the downward thrust of the piercing means overcomes the resilience of the intermediate portion 115 (as shown in Figure 8). This will, of course, depend on the material from which the nut is made and the thickness of that material. It is for such a possibility that the embossment 121 is formed. Recess 118 ensures that the extrusion 32 has ample space into which to move in the event the force is great enough to cause the arms to close. Embossment 121, however, acts as a reinforcement and ensures that the recess 128 remains uncollapsed until the extruding is complete. When shoulder 53 engages the upper surface of the workpiece 30, it performs two functions. It blocks the upward path so that none of the extruded material can escape upwardly while piercing means 52 remains in the aperture 118 ensuring that no material can exist from the lower side of the clinch nut. Further downward pressure causes shoulder 53 to perform its second function of causing embossment 121 to be flattened. This will cause material to collapse into the outer portions of aperture section 128, squeezing the extrusion 32 ensuring that the recesses between the teeth 124 are fully occupied (Figure 9).

As the power cylinder 50 moves upwardly retracting piercing means 52, it also draws linkage member 58 from its dotted-line position to its solid-line position (Figure 6), rotating rocker arm

60 in a counter-clockwise direction. This will cause tangs 64 on finger 62 to engage between adjacent clinch nuts and advance the strip. The overtravel of the pivot finger 62 (as indicated by the dotted-line position in Figure 6) is necessary to permit withdrawal of the piercing means from workpiece 30 before advancement begins. Once piercing means 52 has been withdrawn, the workpiece may be moved laterally or longitudinally of the staking device by means not shown to vary the positioning of the clinch nuts on the workpiece as may be desired. When the downward pressure of the piercing member is removed, arm 114 will rebound to a position approaching that of arm 14 in Figure 3. The exact amount of spring back will depend on how much deformation of intermediate portion 114 takes place (i.e., beyond the elastic limit, etc.). An additional feature of this second embodiment is that there is more material in arm 114 than in the corresponding arm of the Figure 1 to 4 embodiment so there will be greater thread engagement with fastener 34.

Various changes, modifications and alternatives will become apparent to a person of ordinary skill in the art in view of the foregoing specification. Accordingly, it is intended that all such changes, modifications and alternatives as fall within the scope of the appended claims be included as part of the present invention.

CLAIMS

1. A clinch nut of sheet material comprising a first arm member which can engage a workpiece surface with one side thereof; a second arm member interconnected to the first arm member on the side opposite from the workpiece engagement and extending generally parallel to said first arm member; a first aperture in said first arm member adapted to receive an extruded portion of said workpiece; a second aperture in said second arm member which is generally coaxial with said first aperture, at least a portion of said second aperture having a diameter which is less than the diameter of all portions of the first aperture; said first aperture including a first portion with one diameter and a second portion with a larger diameter, said second portion being on the side away from workpiece engagement, and said first aperture also including rotation preventive means, whereby the clinch nut may be axially and rotationally fixed by extruding a portion of said workpiece into said first aperture as by staking, said extrusion extending at least into the second portion of said first aperture.

2. The clinch nut of claim 1, in combination with an extruded portion of a workpiece, and a self-tapping fastener, wherein said self-tapping fastener threadingly engages only the workpiece extrusion in the region of said first arm member and then threadingly engages the aperture in the second arm member.

3. The clinch nut of claim 1, wherein said second arm member is interconnected by a resilient interconnection to said first arm member, and is initially spaced from said first arm member, whereby when a self-tapping fastener is tightened into said extruded portion and into the aperture of the second arm member, said second arm member is deflected towards said first arm member with the resilient interconnection providing a backout retardant for the fastener.

4. The clinch nut of claim 1, wherein said rotation preventive means comprises a plurality of serrations in said first aperture.

5. The clinch nut of claim 1, wherein said rotation preventive means comprises a plurality of teeth-like projections in said first aperture.

6. The clinch nut of claim 1, further comprising an embossment surrounding the second aperture on the side away from the first arm member.

7. A tool for installing a clinch nut onto a workpiece from an interconnected strip of such nuts, comprising a first outer piston mounted for longitudinal movement; a second inner piston mounted for longitudinal movement within a cavity in said first piston; said second piston including piercing means on the leading end thereof, cylinder means connected to said second piston and adapted to move said second piston through a distance exceeding the length of the cavity in said first piston; linkage means pivotally connected to said cylinder means and to a finger; spring biased plunger means positioned generally opposite said first piston; and severing means positioned adjacent said plunger means.

8. A clinch nut as defined in claim 1, substantially as described with reference to Figures 1 and 2 or Figure 7 of the accompanying drawings.

9. A combination of a workpiece and a clinch nut fixed to said workpiece, substantially as described with reference to Figure 3 or Figure 9 of the accompanying drawings.

10. A combination of a workpiece, a clinch nut fixed to said workpiece, and a fastener threadingly engaging said workpiece and nut, substantially as described with reference to Figure 4 of the accompanying drawings.

11. A tool as defined in claim 7, substantially as described with reference to Figure 6 of the accompanying drawings.

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